HELMINTH PARASITES OF THE LONG-FINNED EEL, *ANGUILLA DIEFFENBACHII*, AND THE SHORT-FINNED EEL, *A. AUSTRALIS*

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ABSTRACT

Fifty-four long-finned eels *(Anguilla dieffenbachii)* and forty-seven short-finned eels *(A. australis)* were taken from the Waimakariri and Okuku rivers, and Lake Ellesmere, and examined for helminth parasites. The following trematodes: *Stegodexamene anguillae, Telogaster opisthorchis, Lecitochirium* sp. and a bivesiculid; and the following nematodes: *Spirocamallanus anguillae, Cucullanus anguillae, Paraquimperia novaezelandiae,* and *Anguillicola australiensis,* were recovered. The incidence of parasites differed in the two species, dominants being *Stegodexamene* in the short-finned, and *Spirocamallanus* in the long-finned eel. Food preferences, avoidance reactions of trematodes to nematodes, and host range of *Spirocamallanus,* are suggested to explain this difference. Incidence and number of helminths increased with increasing host length. Differences in incidence and intensity of individual helminth species in each eel species were observed. Each parasite species showed a preference for one gut region.

INTRODUCTION

New Zealand fresh and brackish waters contain two species of eel: *Anguilla dieffenbachii* Gray, Griffin 1936, the long-finned eel, which is found only in New Zealand, and *A. australis schmidtii* Phillipps, Griffin 1936, the short-finned eel, which occurs in New Zealand and Australia.

Eels are becoming increasingly important in New Zealand's export industry. Processed eel is exported, and elvers have been sent to Japan for fish farming. Successful fish farming is possible in New Zealand and a knowledge of the parasites present in the fish is desirable. Individual classes of helminth parasites of eels have been described (Brunsdon 1953, 1956; Macfarlane 1936, 1939, 1945, 1951), but no study has been undertaken on the overall helminth fauna. This study was an attempt to fill that gap.

MATERIALS AND METHODS

Fifty-four long-finned and 47 short-finned eels were examined. Two migratory eels were speared at Lake Ellesmere in May 1970, and the remainder obtained by electric fishing apparatus from the Okuku River, and the South Branch of the Waimakariri. For each eel, the species, length, and where possible, sex, were noted. The gut was removed, and after the accessory organs (liver, gall bladder, spleen and pancreas) were examined, the stomach and intestine were opened, and the mucus lining removed by scraping.

Helminths were removed from this and identified. The body cavity, urinary bladder, air bladder and gill cavities were also examined.

DISCUSSION

HELMINTHS FOUND

Four trematode families, and four nematode families were represented in the long and shortfinned eel (Table 1). All but one trematode and one nematode family were represented in both eel species.

TABLE 1. HELMINTHS FOUND IN LONG-FINNED AND SHORT-FINNED EELS

	Long-finned eel	Short-finned eel
TREMATODA Digenea		
Fam: Allocreadiidae *Stegodexamene anguillae* Macfarlane, 1951	x	x
Fam: Acanthostomatidae *Telogaster opisthorchis* Macfarlane, 1945	x	x
Fam: Hemiuridae Lecithochirium* sp. Lühe, 1901		x
Fam: Bivesiculidae**	x	x
NEMATODA Ascarididea		
Fam: Quimperiidae *Paraquimperia novaezelandiae* Brunsdon, 1956		x
Spiruridea		
Fam: Camallanidae *Spirocamallanus anguillae**** Brunsdon, 1956	x	x
Fam: Cucullanidae *Cucullanus anguillae* Brunsdon, 1953	x	x
Philometridea		
Fam: Anguillicolidae *Anguillicola australiensis***** Johnston and Mawson, 1940	x	x

x Indicates present.
* Only one specimen found - possibly an accidental parasite.
** Ten specimens found, none mature.
*** Previously found only in the long-finned eel.
**** First recorded finding in the short-finned eel.

COMPARISON OF HELMINTHS FROM THE TWO EEL SPECIES FROM DIFFERENT RIVERS

Helminths from South Branch, Waimakariri River

Table 2 summarises the incidence and percentage infection of the two species of eel from the South Branch. The infection of *Telogaster* in *A. dieffenbachii* appears relatively high (1-382),

TABLE 2. INCIDENCE OF HELMINTH SPECIES IN EELS FROM THE SOUTH BRANCH OF WAIMAKARIRI RIVER

	Range	Mean no. per infected eel	Total no.	% incidence	No. of infected eels
Long-finned eel (50 specimens)					
Stegodexamene	1-41	9.9	197	40	20
Spirocamallanus	1-17	5.2	222	86	43
Telogaster	1-382	64.9	454	14	7
Paraquimperia	0	0	0	0	0
Cucullanus	1-17	5.0	45	18	9
Anguillicola	0	0	0	0	0
Bivesiculid	1	1.0	6	12	6
Total parasites	1-454	9.24	924	100	50
Short-finned eel (41 specimens)					
Stegodexamene	1-45	8.2	261	78	32
Spirocamallanus	1-22	5.6	39	17	7
Telogaster	1-17	5.3	21	10	4
Paraquimperia	1-35	6.0	84	34	14
Cucullanus	2	2.0	2	2	1
Anguillicola	1-8	4.5	9	5	2
Bivesiculid	1	1.0	4	10	4
Total parasites	1-80	11.1	420	93	38

but this figure is distorted by one large (0.99 m) eel which contained 382 *Telogaster*, with a total burden of 454 helminths; the next highest total infection was 53, a relatively low infection.

The percentage incidence column reveals differences in the helminth fauna between the two species of eel. *Stegodexamene* was more common in the short-finned eel, while *Spirocamallanus* showed the opposite pattern. A possible reason for this is different food preferences, for *Stegodexamene* enters the eel via *Gobiomorphus goboides* and *Philypnodon* species mainly. Cairns (1942) found that the short-finned eel feeds more heavily on small fish. In an experiment, *Spirocamallanus* larvae were eaten by, and remained alive in, the amphipod *Paracalliope*. Burnet (1969) recovered 3 amphipods per kg body weight in long-finned eels from the South Branch, and none in short-finned eels.

Brunsdon (1956) did not find *Spirocamallanus* in *A. australis*, and considered it physiologically adapted to *A. dieffenbachii* only. It is possible that *Spirocamallanus* is increasing its host range into *A. australis*, where it can now survive but not reproduce, for no mature specimens were recovered in *A. australis*.

Telogaster showed no real differences in distribution and incidence in the two eel species.

The absence of *Paraquimperia* and *Anguillicola* from the long-finned eel, where they have been both previously recorded, could also be due to food preferences of the eels. It is also

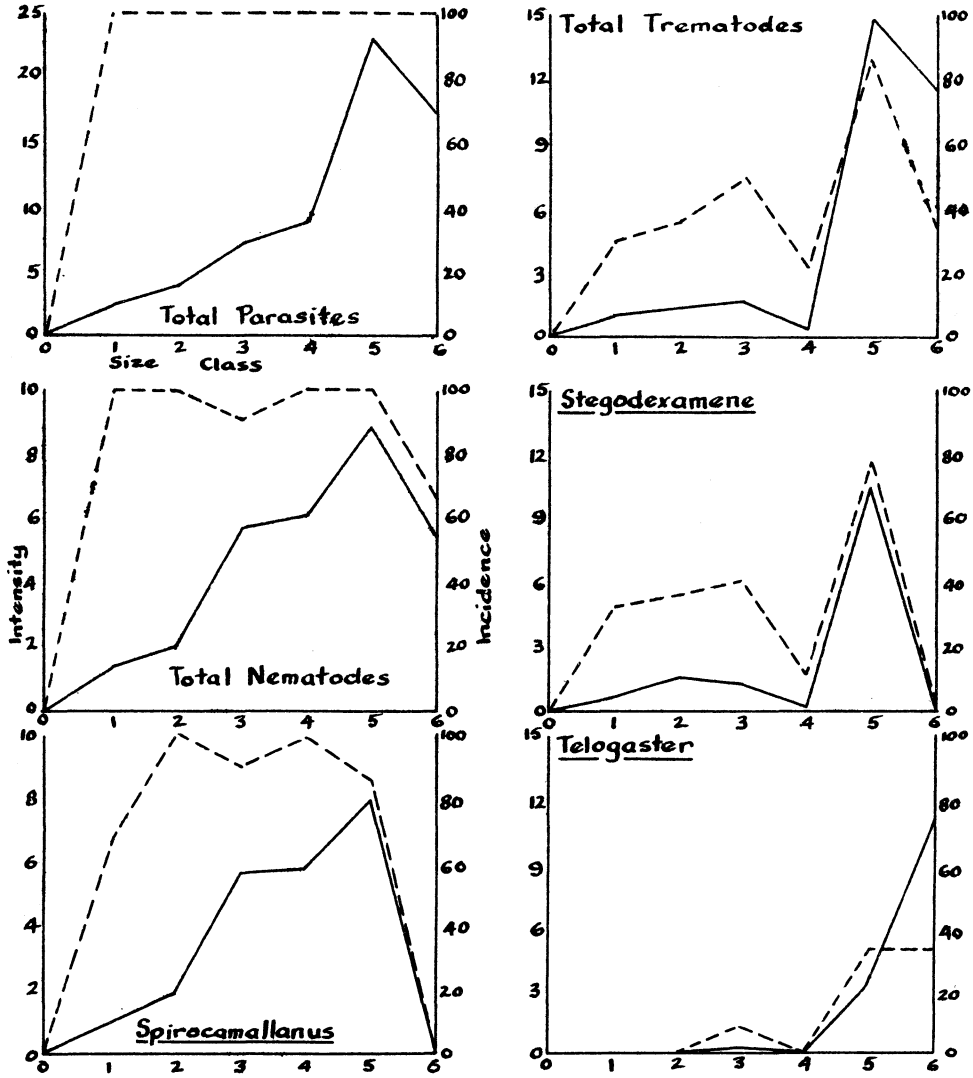

Fig. 1. Incidence and number of helminths in the long-finned eel, Anguilla dieffenbachii.

KEY TO FIGS 1 AND 2

— — — incidence ——— number of helminths

TABLE 3. NO. OF EELS IN SIZE CLASSES 0-6 EXAMINED FOR HELMINTHS

Size class	Length (m)	A. dieffenbachii	A. australis
0	0-0.1	0	0
1	0.1-0.2	3	3
2	0.2-0.3	11	6
3	0.3-0.4	12	11
4	0.4-0.5	9	12
5	0.5-0.6	9	5
6	0.6-0.7	3	4

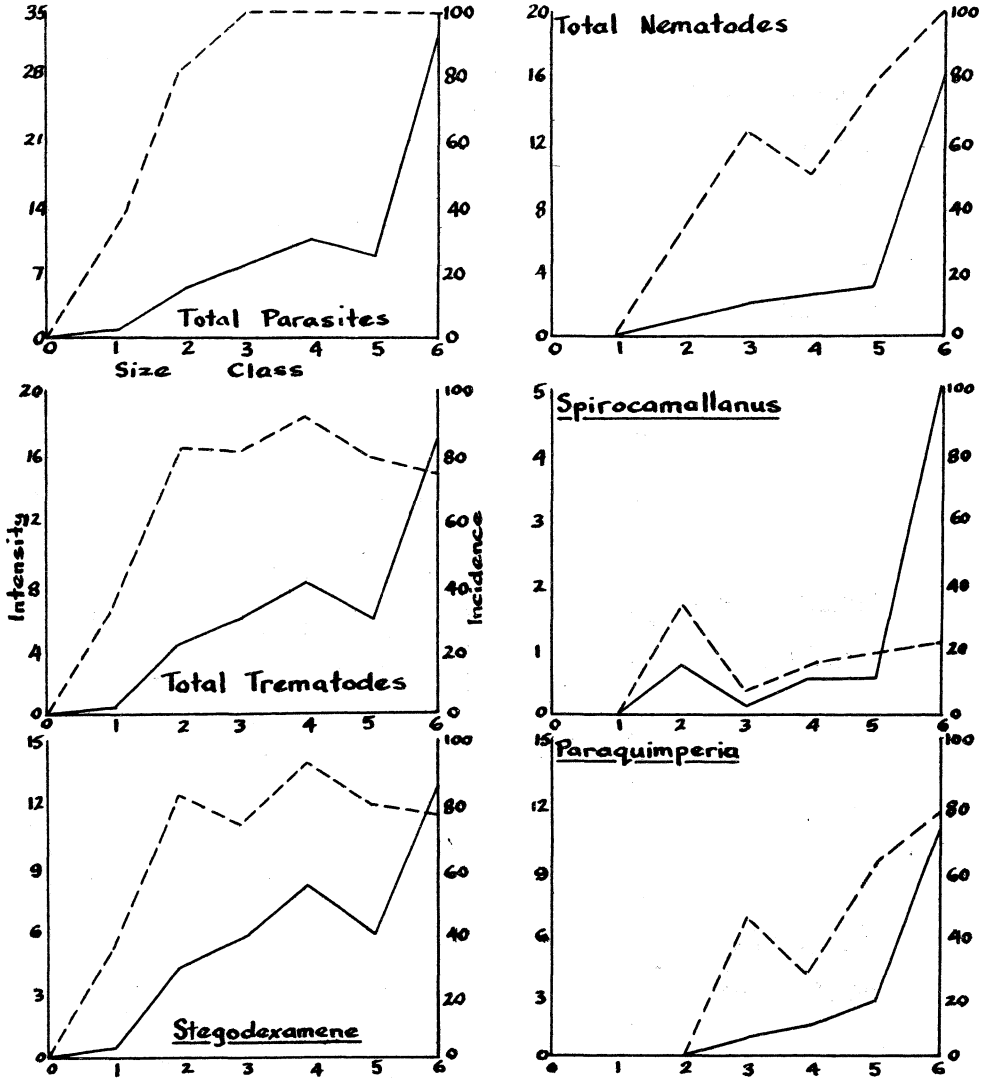

Fig. 2. Incidence and number of helminths in the short-finned eel, Anguilla australis.

possible that *Anguillicola* has difficulty infecting *A. dieffenbachii* in the swift flow of water in the South Branch. Brunsdon (1956) found a higher infection in eels from sluggish waters.

Helminths of eels from other localities

Stegodexamene and *Spirocamallanus* were found in a sample of small eels from the Okuku River. Three long-finned eels were obtained, and one contained a *Spirocamallanus*. Three of the five short-finned eels were parasitised. Two contained a *Spirocamallanus*, and the third had 13 *Stegodexamene* in the anterior intestine and one *Spirocamallanus* in the posterior intestine. The smallest eel (98 mm) was parasitised, which indicates that parasitic invasion occurs at an early age.

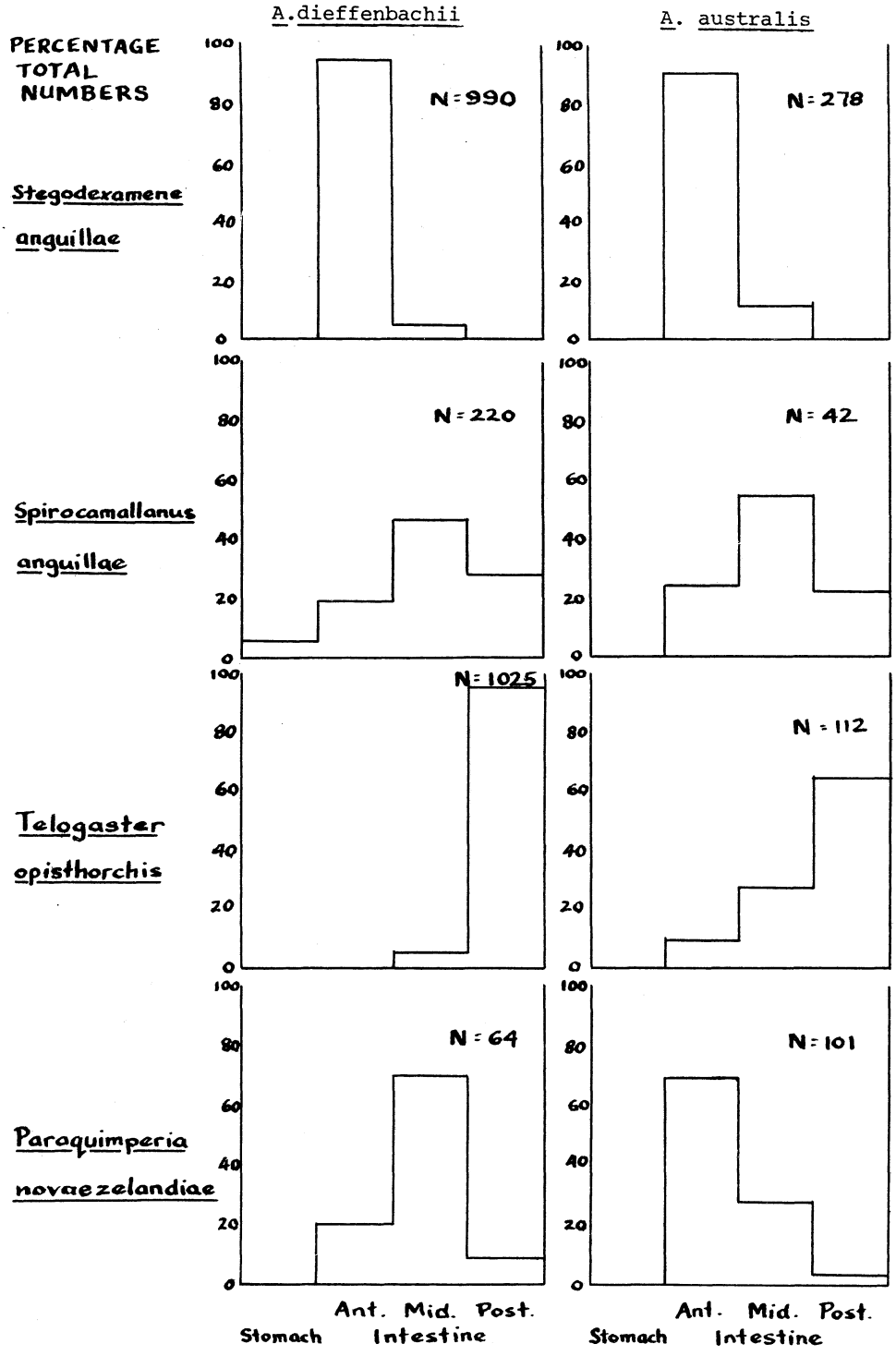

Fig. 3. Distribution of parasites in Anguilla dieffenbachii and A. australis.

Two migratory eels, one female of each species, were speared at the Ellesmere outlet. One hundred and thirteen helminths: 4 *Stegodexamene*, 17 *Paraquimperia*, 91 *Telogaster* and 1 *Lecithochirium* were recovered from the short-finned eel. This parasitic fauna is similar to that in the South Branch eels, and suggests that the eel is from a similar habitat, for Macfarlane (1952) and Brunsdon (1956) both found similar helminth faunas in eels from similar habitats.

The long-finned female was the largest eel examined (1.27 m) and was infected with 1 384 parasites: 793 *Stegodexamene*, 571 *Telogaster*, 19 *Cucullanus* and 1 *Anguillicola*. The ratio of *Stegodexamene* to *Telogaster* (1 : 0.71) indicates that this eel spent most of its life in Lake Ellesmere (Macfarlane 1952). Brunsdon's (1956) findings that *Cucullanus* and *Anguillicola* are the nematodes most commonly found in eels from slow moving waters, support this view.

PARASITISATION AND LENGTH OF HOST

Some of the size classes examined contained as few as three eels (Table 3), and so conclusions about the effect of host length on parasitisation must be treated with caution.

In *A. dieffenbachii* 100% incidence of parasites is reached in the first size class considered, and is maintained through all following size classes (Fig. 1). There is also a general increase in intensity of parasitisation with increasing length. This is typical of fish hosts (Dogiel 1964). The two helminth groups considered separately do not follow this general pattern, for the incidence fluctuates. With one exception (the small size class 6 sample) however, as the percentage incidence of any one species increases with size, so does the intensity of that species

In *A. australis* the percentage incidence of total parasites does not reach 100% until size class 3 (Fig. 2). The intensity of infection reaches higher levels in *A. australis* compared with *A. dieffenbachii* in size class 6, but prior to this, the two species show very similar intensities. Individual helminth species differ in incidence and intensity in the two species. *Stegodexamene* is higher in *A. australis* than the two nematodes combined, while *Spirocamallanus* is higher than the two trematodes in *A. dieffenbachii*.

DISTRIBUTION OF HELMINTHS IN THE GUT

Each helminth species occurred in different regions of the gut in differing frequencies (Fig. 3). *Stegodexamene* showed almost 100% incidence in the anterior region of the gut, while *Telogaster* moved into the mid intestine from the posterior when nematode infection of the mid gut was less (as seen in *A. australis*). The repellant effect of nematodes on trematodes (Macfarlane 1936) is the probable reason for this.

All the available microhabitats in the intestine seemed to be occupied by both nematodes and trematodes. The stomach was little utilised, which is surprising for eel digestion is very slow.

Effects of parasites on host

None of the eels studied exhibited harmful effects. One eel which may have been adversely affected by its parasites was a small short-finned eel (312 mm) which had eight *Anguillicola* in its air bladder. This left very little free space in the air bladder, and could possibly have affected swimming ability.

CONCLUSIONS

This comparison of the helminth fauna of the two species of eel revealed differences in the species of helminth present and their distribution. Infestation occurred when the eel was small and intensity of infection increased with increasing length, but rarely reached high levels.

The study of the parasites of eels is by no means complete. This study was mainly concerned with eels from a small, fast-flowing stream; eels in slower waters must be examined. The seasonal occurrence of helminths needs investigation, and very little is known of the life cycles of the nematode parasites.

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LITERATURE CITED

BRUNSDON, R.V. 1953. A systematic study of the nematodes parasitic in New Zealand marine fish, with an account of the life history and culture of Stomachus marinus (Linn, 1767). Unpub. M.Sc. thesis, Victoria University of Wellington, New Zealand.

BRUNSDON, R.V. 1956. Studies on nematode parasites of New Zealand fishes. Unpub. Ph.D. thesis, Victoria University of Wellington, New Zealand.

BURNET, A.M.R. 1969. A study of the inter-relation between eels and trout, the invertebrate fauna and the feeding habits of the fish. Fisheries Technical Report, New Zealand Marine Department 36: 23 pp.

CAIRNS, D. 1942. Life history of the two species of freshwater eels in New Zealand. Part II. Food and inter-relationships with trout. New Zealand Journal of Science and Technology 23(4B): 132-148.

DOGIEL, V.A. 1964. General parasitology. Oliver and Boyd, Edinburgh and London. 516 pp.

MACFARLANE, W.V. 1936. Life cycles of four New Zealand trematodes: Bionomics of Opechona, Telogaster, Coitocaecum and Fasciola. Unpub. M.Sc. thesis, University of Canterbury, New Zealand.

———————— 1939. The life cycle of Coitocaecum anaspidis Hickman, a New Zealand digenetic trematode. Parasitology 31: 172-184.

———————— 1945. The life cycle of Stegodexamene anguillae n. sp. an allocreadiid trematode from New Zealand. Parasitology 41: 1-10.

———————— 1952. Bionomics of two trematode parasites of New Zealand eels. Journal of Parasitology 38: 391-397.